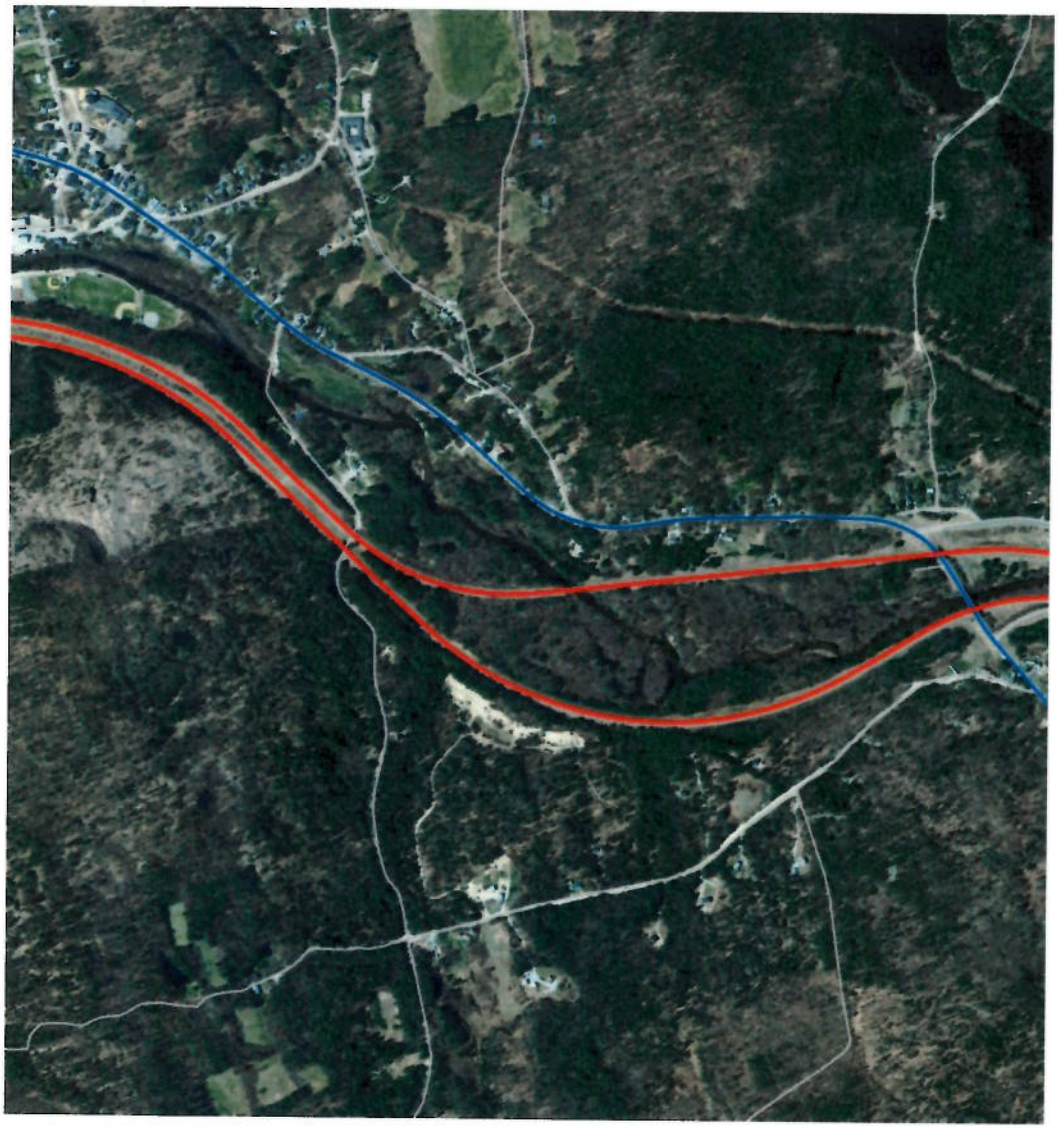
horizons Engineering Inc.



GROUNDWATER DISCHARGE FEASIBILITY INVESTIGATION

Warner Village Water District

Warner, New Hampshire

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APPENDICES

1.0 INTRODUCTION

The Town of Warner owns and operates a wastewater treatment facility (WWTF) with a NPDES permit (NH0100498) to discharge 110,000 gpd of treated wastewater to the Warner River. The WWTF has experienced repeated permit violations, primarily related to copper. The Town would like to convert the WWTF from surface water discharge to groundwater discharge under a State of New Hampshire Groundwater Discharge Permit. Options under consideration include rapid infiltration basins, spray irrigation, and drip irrigation. A Site Location Plan and an Aerial Photograph of the area are included in **Appendix 1**.

1.1 Area of Study

Discussions with the Warner Village Water District (District) identified four (4) separate areas in relatively close proximity to the WWTF. For the purpose of this report these have been identified as Study Parcels A, B, C, and D. These are generally described as follows:

- Study Parcel A is a property located between Riverside Lane and Interstate 89 northwesterly of the WWTF. It is currently used as a Town recreation area.
- Study Parcel B is a large predominantly wooded area located south of Interstate 89 and west of West Joppa Road. The area includes property owned by six (6) separate parties.
- Study Parcel C is located south of Interstate 89 and east of West Joppa Road. The area includes property owned by five (5) separate parties.
- Study Parcel D is owned by the State of New Hampshire and located between the north- and south-bound lanes of Interstate 89 southeasterly of the WWTF.

A plan showing the study parcels on an aerial photograph base is included as **Appendix 2**.

2.0 PHASE I - DATA COLLECTION

The first step in evaluating the study parcels was to collect readily available published data. This was used to make a first cut determination of site suitability based on various physical and environmental criteria. Data collected as part of the preliminary site assessment included the applicable Town of Warner Tax Map, parcel owners, USGS topographic mapping, NRCS soils mapping and information, FEMA floodplain mapping, National Wetland Inventory mapping, conservation area mapping, aquifer mapping, and wellhead protection areas.

Based on this information the following impediments were identified for various Study Parcels:

- Parcel A – Town park, FEMA regulatory floodplain.
- Parcel B – Slope, probable bedrock between 20" and 40", and some conservation land.
- Parcel D – On the NWI map, FEMA regulatory floodplain, owned by the State of New Hampshire.

Only Study Parcel C was identified as having good potential for a groundwater discharge system.

A preliminary report was forwarded to the District for review. A copy of all preliminary site assessment documentation will be found in **Appendix 3.**

3.0 PHASE 2 – SITE VISIT

Based on a review of the preliminary siting assessment the District requested a site walkover of Study Parcel C, specifically that portion of the area previously used as a sand and gravel pit. On January 13, 2017 Bruce Cox of Horizons participated in a site visit with personnel of the District.

The sand and gravel pit is located on Tax Map 10, Lots 54, 54-1, and 54-3. These are owned by Edward Ordway, Anne Goff, and Peter Wyman respectively. The area that has been worked is approximately 1,100 feet long by 100' to 150' wide. The pit is accessed by a dirt road. The bottom of the pit is uneven and at several different elevations. A large frozen puddle was observed in the deepest depression, but it could not be ascertained if this was an expression of the water table or just a perched puddle. The area at the time of the walkover was mostly snow covered, but there were some snow-free areas. The observed surface consisted of coarse sand and fine gravel. There are, however, piles of boulders, some of which are large. Per the NRCS the soil type in the sand and gravel pit area is Udipsamments. Udipsamments are generally described as nearly level soils in floodplains that have been altered by grading and by cutting and filling. Although the properties of Udipsamments are difficult to define, the NRCS rates them as having a high to very high ability to transmit water (6 in/hr to 20 in/hr).

The Water Department personnel were not aware if the pit had been worked to its practical limits or not. The overall impression of Horizons was that it had not been. An attempt was made to advance a hand auger in two locations; one on the upper level, and one in a lower level. The one in the upper level went to approximately 3.5' in medium grained sand. Refusal appeared to be on a gravelly layer. The one in the lower level went to approximately 1' in medium grained sand, with refusal on an apparent gravelly layer.

Information obtained from the NHDES OneStop database indicates the depth to bedrock for water supply wells in the vicinity ranges from 56' to 240'. This suggests the sand and gravel deposits may be thick. The thickness of the aquifer is an important factor in its ability to transmit applied water. A copy of the water well map annotated with depths to bedrock is included as **Appendix 4.**

In Horizons opinion this area warranted further study if permission could be obtained from the property owners. Soil conditions appear generally conducive to a rapid infiltration basin system in the 80,000 gpd range, there is plenty of room, and apparent adequate material if filling is necessary to obtain water table separation.

4.0 PHASE 4 – STUDY PARCEL C ALTERNATIVES

The District approached the owners of the gravel pit area concerning the construction of rapid infiltration basins. The response was generally favorable toward working with the District, but not for rapid infiltration basins. Given current land use and topographic conditions this suggested a drip irrigation system. The owner(s) found this acceptable.

At some point during these discussions the District identified one additional parcel for consideration. This is a Town owned property on the opposite side of the Warner River across from the WWTF. A drive by inspection by Horizons personnel indicated unsuitability based on floodplain and wetness issues. Therefore, Horizons proceeded with a conceptual drip irrigation system on Study Parcel C.

4.1 Conceptual Drip Irrigation System Design

Per the NHDES publication Land Treatment and Disposal of Reclaimed Wastewater: Guidance for Groundwater Discharge Permitting, revised July 30, 2010, a drip irrigation system is considered a Slow Rate system. In a drip irrigation system treated wastewater is applied to soil slowly and uniformly under pressure using a network of narrow tubing placed below ground level at shallow depth. The method is typically operable throughout the year.

Slow rate systems achieve treatment and disposal by slow rate application of primary or secondary effluent onto moderately permeable cultivated or forested land. Typical soil permeabilities are in the range of 0.2 to 2.0 inches per hour and are normally associated with loamy soils. Application rates typically vary from 0.5 to 4.0 inches per week, including precipitation. The following WWTF effluent requirements apply:

Minimum treatment required: primary with filtration;
BOD5: ≤30 mg/L;
TSS: ≤ 30 mg/L;
Nitrate: site specific;
Disinfection: not required; and
Turbidity: no limit set.

It is our understanding that the WWTF currently meets these requirements.

Per the NHDES publication referenced above the wastewater field application rate is calculated by the formula:

$$A = \frac{Q\left(\frac{ft^3}{7.48}gal\right) \times 365\frac{day}{yr} + dV}{Lw \times N \times \left(\frac{ft}{12}in\right) \times \left(43{,}560\frac{ft^2}{acre}\right)}$$

Where:

- A = field area, in acres
- Q = wastewater flow, in gallons per day
- dV = net loss or gain in stored water volume because of precipitation and/or evaporation, in cubic feet per day
- Lw = design hydraulic loading rate, in inches per day
- N = number of days of operation, in days per year

Hydraulic loading rate is calculated on a site-specific basis using the water balance equation:

$$Lw = ET - P + Wp$$

Where:

- Lw = wastewater hydraulic loading rate based on soil permeability, in depth per time
- ET = design evapotranspiration rate based on the estimated average evapotranspiration of the crop, in depth per time
- P = design precipitation rate based on total precipitation for the wettest year in the previous 10-year design period, in depth per time
- Wp = design percolation rate as measured in the field, in depth per time

A copy of the calculations, along with the data sources and assumptions is included in **Appendix 5**. The calculation shows the required field size is approximately 1.9 acres.

Also included in Appendix 5 is a calculation done using a spreadsheet prepared by Geoflow, Inc., a manufacturer/ designer of drip irrigation systems. This calculation also results in a field size of 1.9 acres. Being conservative and assuming fine sand with a loading rate of 0.9 gal/sf/day results in a field 2.5 acres in size.

These calculations are based on published precipitation and evapotranspiration data for this region. The wildcard is the hydraulic properties of the site soil. To finalize a design the range in soil percolation rates will need to be determine based on field tests.

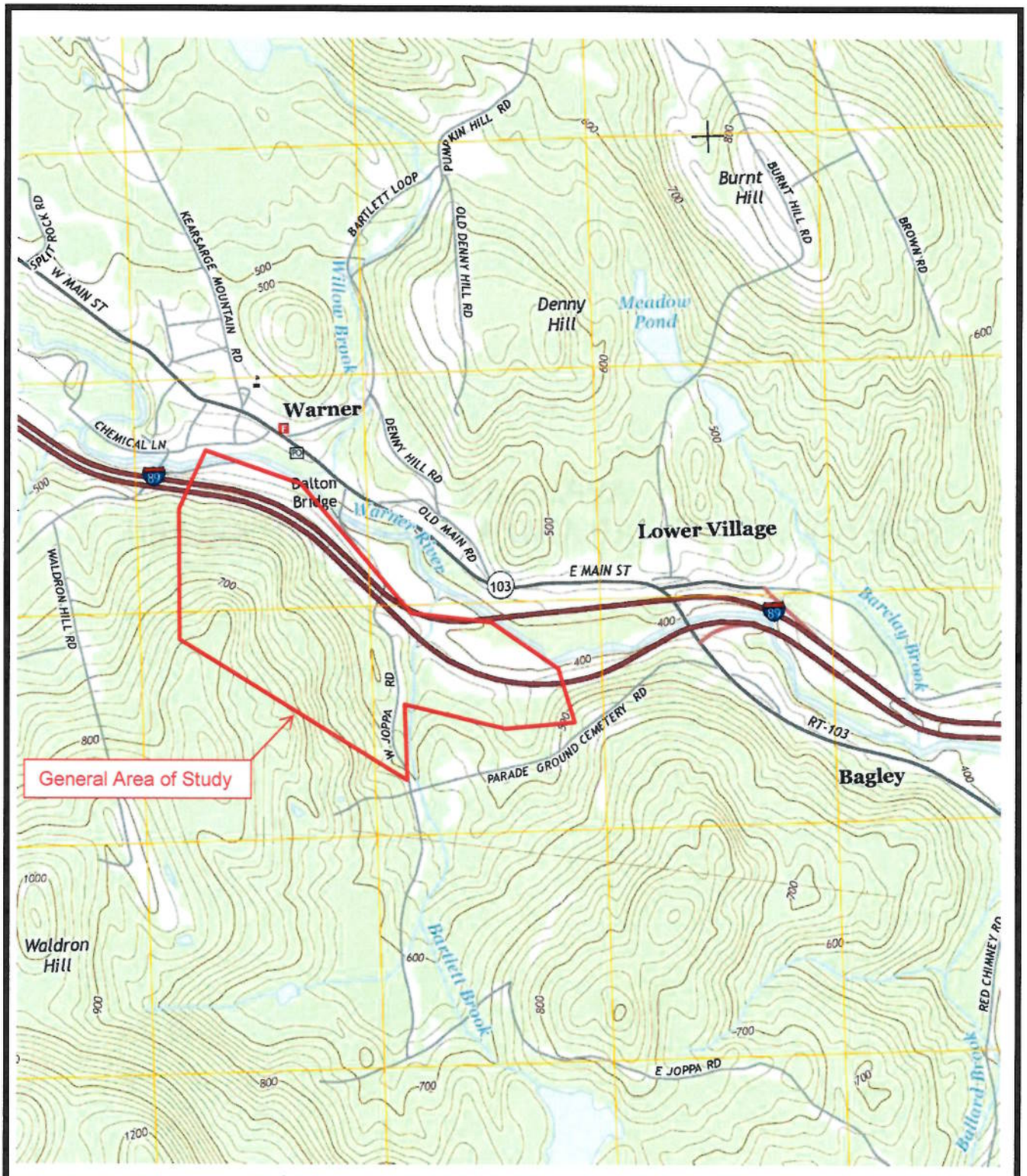
Another consideration is the height of the groundwater mound that will grow under the field. When liquid is applied to the ground surface it seeps into the ground. In order for the liquid to flow away from the application area, a hydraulic gradient must be induced. This is done by the water table mounding up under the field. The DES publication specifies that between one and three feet of unsaturated soil must be present between the top of the groundwater mound and the bottom of the drip tubes. The groundwater mounding is calculated using another computer program. Required input includes hydraulic conductivity and the saturated thickness of the aquifer. A detailed test boring program and field testing will be needed to determine soil types and thicknesses, the depth to bedrock or other impervious layer, and hydraulic conductivity.

5.0 SUMMARY AND RECOMMENDATIONS

Horizons has completed a preliminary groundwater discharge feasibility investigation for the Warner Village Water District. The majority of the study parcels were discounted for one or more reasons including current use, current ownership, wetlands, floodplains, and slope.

Study Parcel C, a sand and gravel pit located southeasterly of the WWTF, has potential for use as a groundwater discharge site. Preliminary contact by the District indicates that the owner(s) are amenable to a drip irrigation system. Our preliminary site walkover and sizing calculations indicate this property has the potential to support a drip irrigation system capable of handling an effluent flow of 100,000 gpd. The required disposal field size is approximately 2 to 2.5 acres.

APPENDIX 1
SITE LOCATION MAP AND AERIAL PHOTOGRAPH



horizons Engineering Inc.

34 School Street
Littleton, NH 03561
Phone: 603.444.4111 – Fax 603.444.1343

WARNER VILLAGE WATER DISTRICT

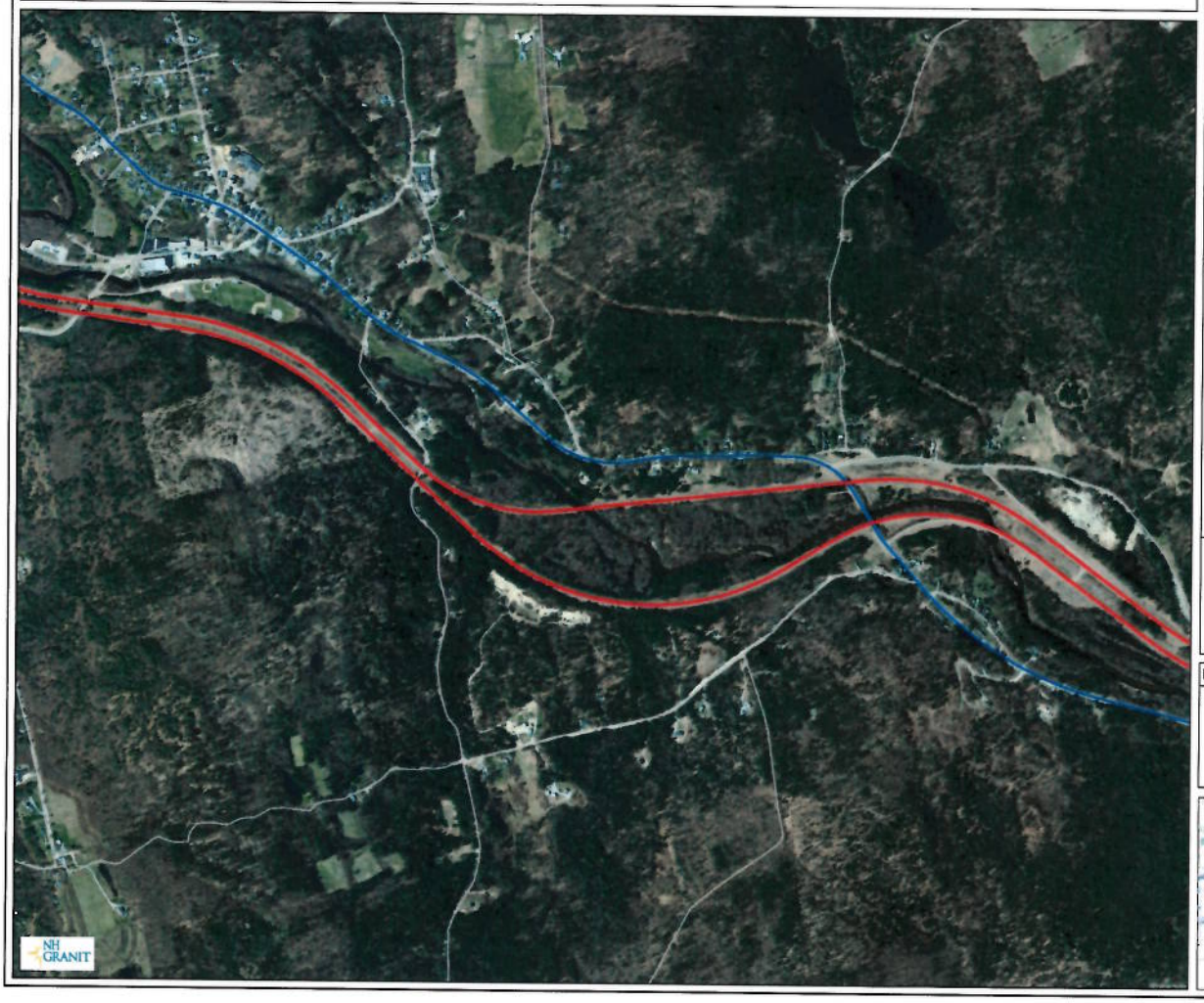
GROUNDWATER DISCHARGE FEASIBILITY

WARNER, NEW HAMPSHIRE

SITE LOCATION MAP

PROJECT #:	16133
ENGIN'D BY:	BHC
DRAWN BY:	BHC
DATE:	DEC 22, 2016

Aerial Photograph



Legend

- State
- County
- City/Town
- Interstates
- Turnpikes
- US Routes
- State Routes
- Local Roads

Map Scale
1: 15,363

Map Generated: 2/10/2017

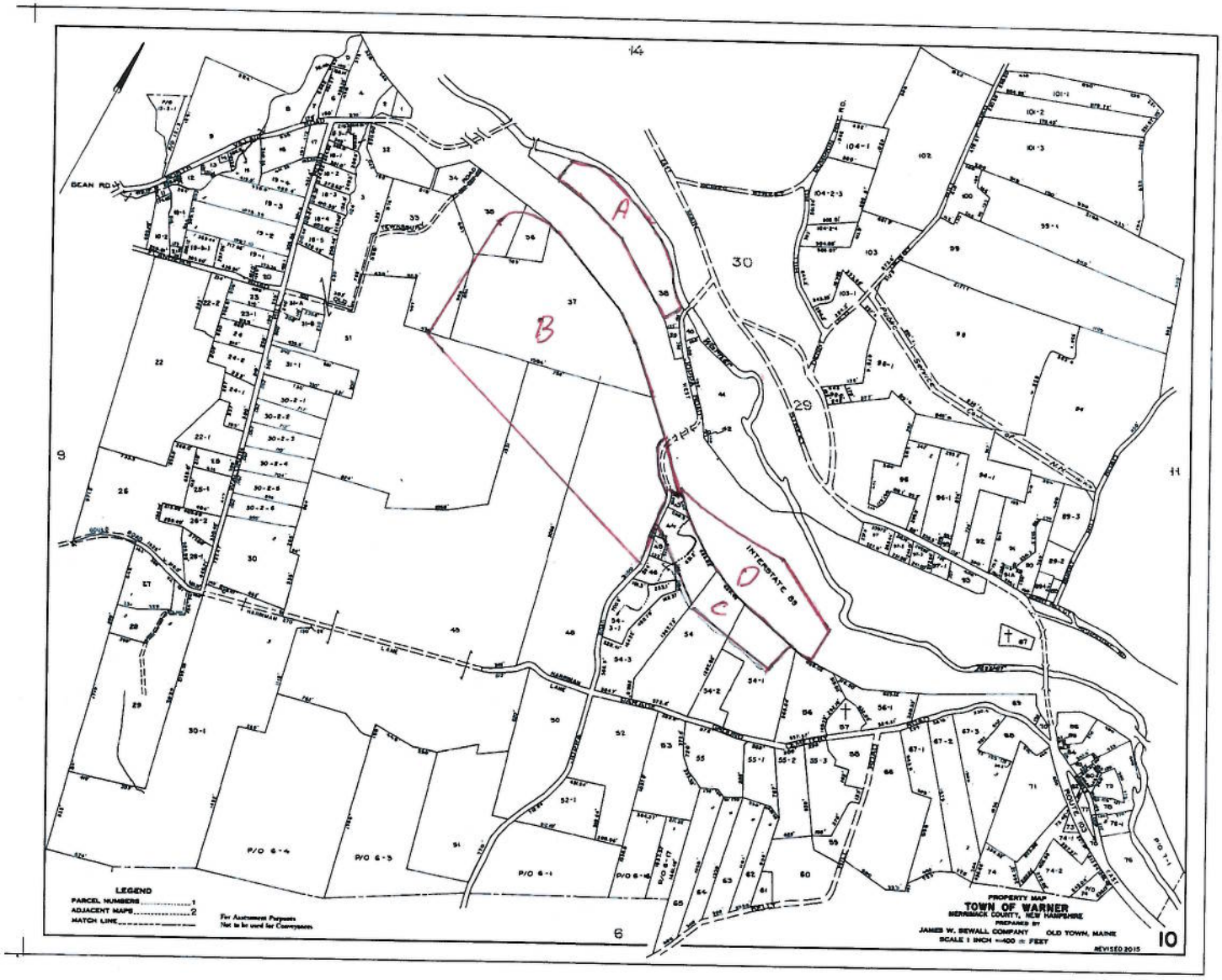
Notes

APPENDIX 2
LOCATION PLAN OF STUDY PARCELS

Warner Groundwater Discharge Feasibility
Parcel Location Plan

A, B, C, D = Parcel Designations

APPENDIX 3
PRELIMINARY SITE ASSESSMENT DOCUMENTATION


A
B
C
D
INTERSTATE 89
BEAN RD
LEGEND
PARCEL NUMBERS 1
ADJACENT MAPS 2
MATCH LINE ..... ——
For Assessment Purposes
Not to be used for Conveyance
PROPERTY MAP
TOWN OF WARNER
MERRIMACK COUNTY, NEW HAMPSHIRE
PREPARED BY
JAMES W. SEWALL COMPANY OLD TOWN, MAINE
SCALE 1 INCH = 400 ± FEET
REVISED 2015
10

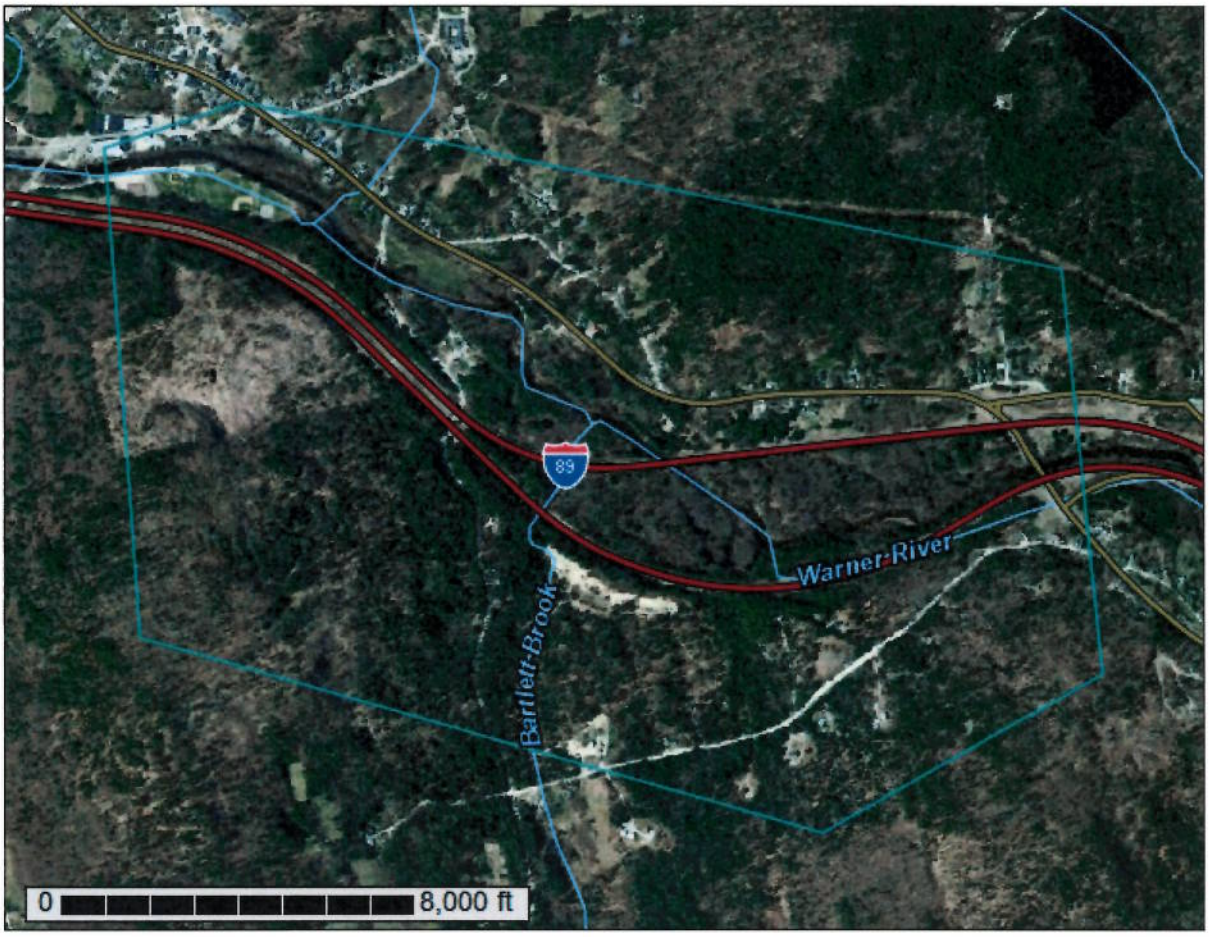
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

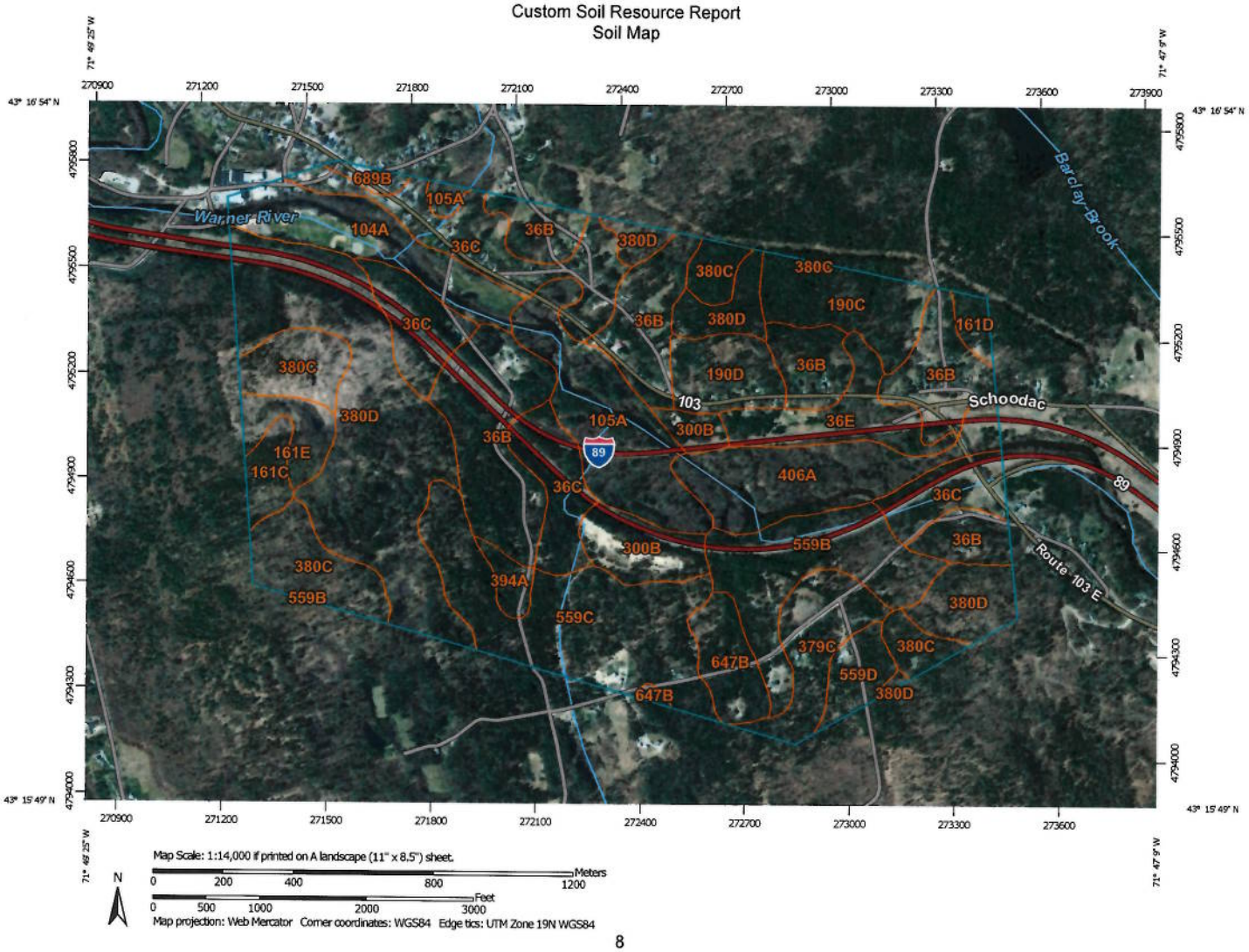
A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Merrimack and Belknap Counties, New Hampshire



December 19, 2016

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Merrimack and Belknap Counties, New Hampshire
Survey Area Data: Version 21, Sep 15, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 8, 2011—May 1, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Merrimack and Belknap Counties, New Hampshire (NH609)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
36B	Adams loamy sand, 3 to 8 percent slopes	103.5	15.1%
36C	Adams loamy sand, 8 to 15 percent slopes	74.7	10.9%
36E	Adams loamy sand, 15 to 60 percent slopes	20.9	3.0%
104A	Podunk fine sandy loam, 0 to 3 percent slopes, frequently flooded	29.4	4.3%
105A	Rumney fine sandy loam, 0 to 3 percent slopes, frequently flooded	41.7	6.1%
161C	Tunbridge-Lyman-Rock outcrop complex, 8 to 15 percent slopes	7.5	1.1%
161D	Lyman-Tunbridge-Rock outcrop complex, 15 to 35 percent slopes	3.9	0.6%
161E	Lyman-Tunbridge-Rock outcrop complex, 35 to 60 percent slopes	10.4	1.5%
190C	Adams-Lyman complex, 8 to 15 percent slopes	22.4	3.3%
190D	Adams-Lyman complex, 15 to 35 percent slopes	16.2	2.4%
300B	Udipsamments, 0 to 6 percent slopes	19.2	2.8%
379C	Peru fine sandy loam, 8 to 15 percent slopes, very stony	21.0	3.1%
380C	Tunbridge-Lyman-Becket complex, 8 to 15 percent slopes, very stony	43.7	6.4%
380D	Tunbridge-Lyman-Becket complex, 15 to 25 percent slopes, very stony	109.0	15.9%
394A	Chocorua mucky peat, 0 to 1 percent slopes	4.7	0.7%
406A	Medomak mucky silt loam, 0 to 2 percent slopes, frequently flooded	36.4	5.3%
559B	Skerry fine sandy loam, 3 to 8 percent slopes, very stony	38.5	5.6%
559C	Skerry fine sandy loam, 8 to 15 percent slopes, very stony	57.2	8.3%
559D	Skerry fine sandy loam, 15 to 25 percent slopes, very stony	9.3	1.3%

Merrimack and Belknap Counties, New Hampshire (NH609)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
647B	Pillsbury fine sandy loam, 0 to 8 percent slopes, very stony	14.4	2.1%
689B	Adams-Urban land complex, 0 to 8 percent slopes	2.9	0.4%
Totals for Area of Interest		686.8	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Merrimack and Belknap Counties, New Hampshire

36B—Adams loamy sand, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9dk8
Elevation: 250 to 2,940 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 37 to 46 degrees F
Frost-free period: 90 to 135 days
Farmland classification: Farmland of local importance

Map Unit Composition

Adams and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Adams

Setting

Landform: Outwash terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy outwash derived mainly from granite, gneiss and schist

Typical profile

Oe - 0 to 1 inches: slightly decomposed plant material
H1 - 1 to 5 inches: loamy sand
H2 - 5 to 17 inches: loamy sand
H3 - 17 to 31 inches: sand
H4 - 31 to 65 inches: sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Colton

Percent of map unit: 8 percent
Landform: Terraces
Down-slope shape: Linear
Across-slope shape: Linear

Hydric soil rating: No

Champlain

Percent of map unit: 5 percent
Landform: Terraces
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Croghan

Percent of map unit: 5 percent
Landform: Terraces
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Groveton

Percent of map unit: 2 percent
Landform: Terraces
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

36C—Adams loamy sand, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 9dk9
Elevation: 250 to 2,940 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 37 to 46 degrees F
Frost-free period: 90 to 135 days
Farmland classification: Farmland of local importance

Map Unit Composition

Adams and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Adams

Setting

Landform: Outwash terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy outwash derived mainly from granite, gneiss and schist

Typical profile

Oe - 0 to 1 inches: slightly decomposed plant material
H1 - 1 to 5 inches: loamy sand
H2 - 5 to 17 inches: loamy sand
H3 - 17 to 31 inches: sand

H4 - 31 to 65 inches: sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Colton

Percent of map unit: 10 percent
Landform: Terraces
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Champlain

Percent of map unit: 5 percent
Landform: Terraces
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Croghan

Percent of map unit: 3 percent
Landform: Terraces
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Groveton

Percent of map unit: 2 percent
Landform: Terraces
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

380C—Tunbridge-Lyman-Becket complex, 8 to 15 percent slopes, very stony

Map Unit Setting

National map unit symbol: 9dkd
Elevation: 200 to 2,940 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 37 to 46 degrees F
Frost-free period: 90 to 135 days
Farmland classification: Farmland of local importance

Map Unit Composition

Tunbridge and similar soils: 35 percent
Lyman and similar soils: 20 percent
Becket and similar soils: 20 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tunbridge

Setting

Landform: Hillslopes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Till

Typical profile

Oe - 0 to 1 inches: slightly decomposed plant material
H1 - 1 to 4 inches: fine sandy loam
H2 - 4 to 21 inches: fine sandy loam
H3 - 21 to 33 inches: cobbly fine sandy loam
H4 - 33 to 37 inches: bedrock

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Low to high (0.01 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B

Hydric soil rating: No

Description of Lyman

Setting

Landform: Hillslopes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Till

Typical profile

Oe - 0 to 2 inches: slightly decomposed plant material
H1 - 2 to 6 inches: very fine sandy loam
H2 - 6 to 13 inches: fine sandy loam
H3 - 13 to 17 inches: bedrock

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Low to high (0.01 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Becket

Setting

Landform: Hills
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Basal melt-out till derived from granite, gneiss, or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
H1 - 1 to 4 inches: fine sandy loam
H2 - 4 to 24 inches: sandy loam
H3 - 24 to 65 inches: loamy sand

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 20 to 36 inches to densic material
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: About 16 to 34 inches

Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Monadnock

Percent of map unit: 4 percent
Landform: Hillslopes
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Skerry

Percent of map unit: 4 percent
Landform: Hillslopes
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Rock outcrop

Percent of map unit: 4 percent
Hydric soil rating: Unranked

Marlow

Percent of map unit: 4 percent
Landform: Drumlins
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Searsport

Percent of map unit: 3 percent
Landform: Outwash terraces
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Moosilauke

Percent of map unit: 3 percent
Landform: Ground moraines
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: Yes

Millsite

Percent of map unit: 1 percent
Landform: Hillslopes
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Woodstock

Percent of map unit: 1 percent
Landform: — error in exists on —
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Henniker

Percent of map unit: 1 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

380D—Tunbridge-Lyman-Becket complex, 15 to 25 percent slopes, very stony

Map Unit Setting

National map unit symbol: 9dkf
Elevation: 200 to 2,940 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 37 to 46 degrees F
Frost-free period: 90 to 135 days
Farmland classification: Farmland of local importance

Map Unit Composition

Tunbridge and similar soils: 35 percent
Becket and similar soils: 20 percent
Lyman and similar soils: 20 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tunbridge

Setting

Landform: Hillslopes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Till

Typical profile

Oe - 0 to 1 inches: slightly decomposed plant material
H1 - 1 to 4 inches: fine sandy loam
H2 - 4 to 21 inches: fine sandy loam
H3 - 21 to 33 inches: cobbly fine sandy loam
H4 - 33 to 37 inches: bedrock

Properties and qualities

Slope: 15 to 25 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Low to high (0.01 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Becket

Setting

Landform: Hills
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Basal melt-out till derived from granite, gneiss, or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
H1 - 1 to 4 inches: fine sandy loam
H2 - 4 to 24 inches: sandy loam
H3 - 24 to 65 inches: loamy sand

Properties and qualities

Slope: 15 to 25 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 20 to 36 inches to densic material
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: About 16 to 34 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C/D
Hydric soil rating: No

Description of Lyman

Setting

Landform: Hillslopes
Down-slope shape: Linear

Across-slope shape: Linear
Parent material: Till

Typical profile

Oe - 0 to 2 inches: slightly decomposed plant material
H1 - 2 to 6 inches: very fine sandy loam
H2 - 6 to 13 inches: fine sandy loam
H3 - 13 to 17 inches: bedrock

Properties and qualities

Slope: 15 to 25 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Low to high (0.01 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Skerry

Percent of map unit: 4 percent
Landform: Hillslopes
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Marlow

Percent of map unit: 4 percent
Landform: Drumlins
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Monadnock

Percent of map unit: 4 percent
Landform: Hillslopes
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Rock outcrop

Percent of map unit: 4 percent
Hydric soil rating: Unranked

Moosilauke

Percent of map unit: 3 percent
Landform: Ground moraines

Merrimack and Belknap Counties, New Hampshire

300B—Udipsamments, 0 to 6 percent slopes

Map Unit Setting

National map unit symbol: 23g13
Elevation: 200 to 2,940 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 37 to 55 degrees F
Frost-free period: 90 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Udipsamments and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udipsamments

Setting

Landform: Terraces
Parent material: Outwash

Typical profile

H1 - 0 to 1 inches: loamy sand
H2 - 1 to 65 inches: gravelly sand

Properties and qualities

Slope: 0 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Adams

Percent of map unit: 3 percent
Landform: Outwash terraces
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Champlain

Percent of map unit: 2 percent
Landform: Terraces
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Windsor

Percent of map unit: 2 percent
Landform: Terraces
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Hinckley

Percent of map unit: 1 percent
Landform: Terraces
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Colton

Percent of map unit: 1 percent
Landform: Terraces
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

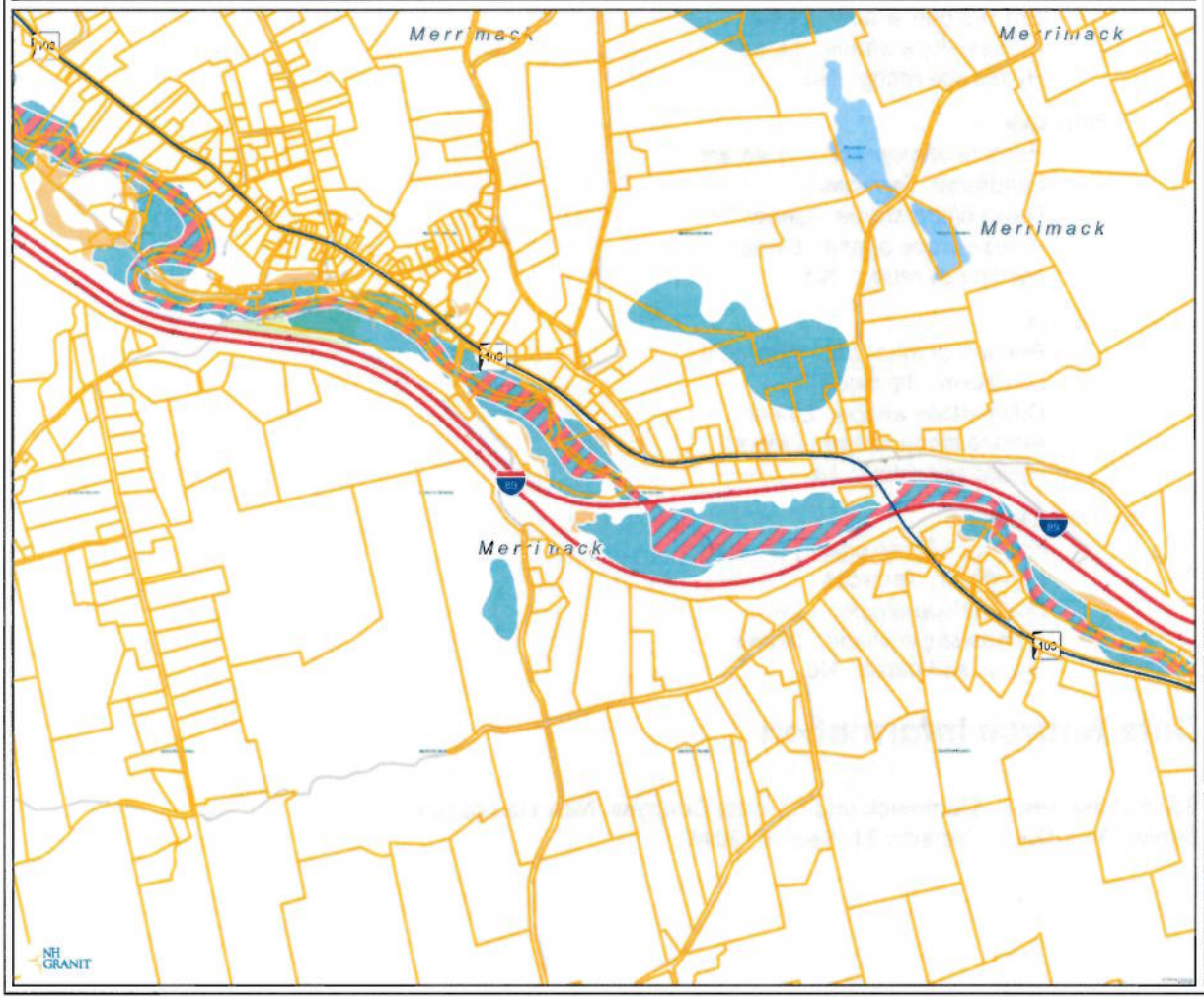
Boscawen

Percent of map unit: 1 percent
Landform: Terraces
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Data Source Information

Soil Survey Area: Merrimack and Belknap Counties, New Hampshire
Survey Area Data: Version 21, Sep 15, 2016

Parcels and FEMA Regulatory Floodplain



Legend

- Parcels - polygons
- State
- County
- City/Town
- Interstates
- Turnpikes
- US Routes
- State Routes
- Local Roads
- Flood Hazard - Lines
  - SFHA/Flood Zone Boundary
  - Limit Lines
  - Zone Break
- Flood Hazard - Areas
  - 1 pct. Annual Chance Flood Hazard
  - Floodway
  - 0.2 pct. Annual Chance Flood Haza
  - Area of Undetermined Flood Hazar
  - Area Protected by Levee

Map Scale
1: 17,921

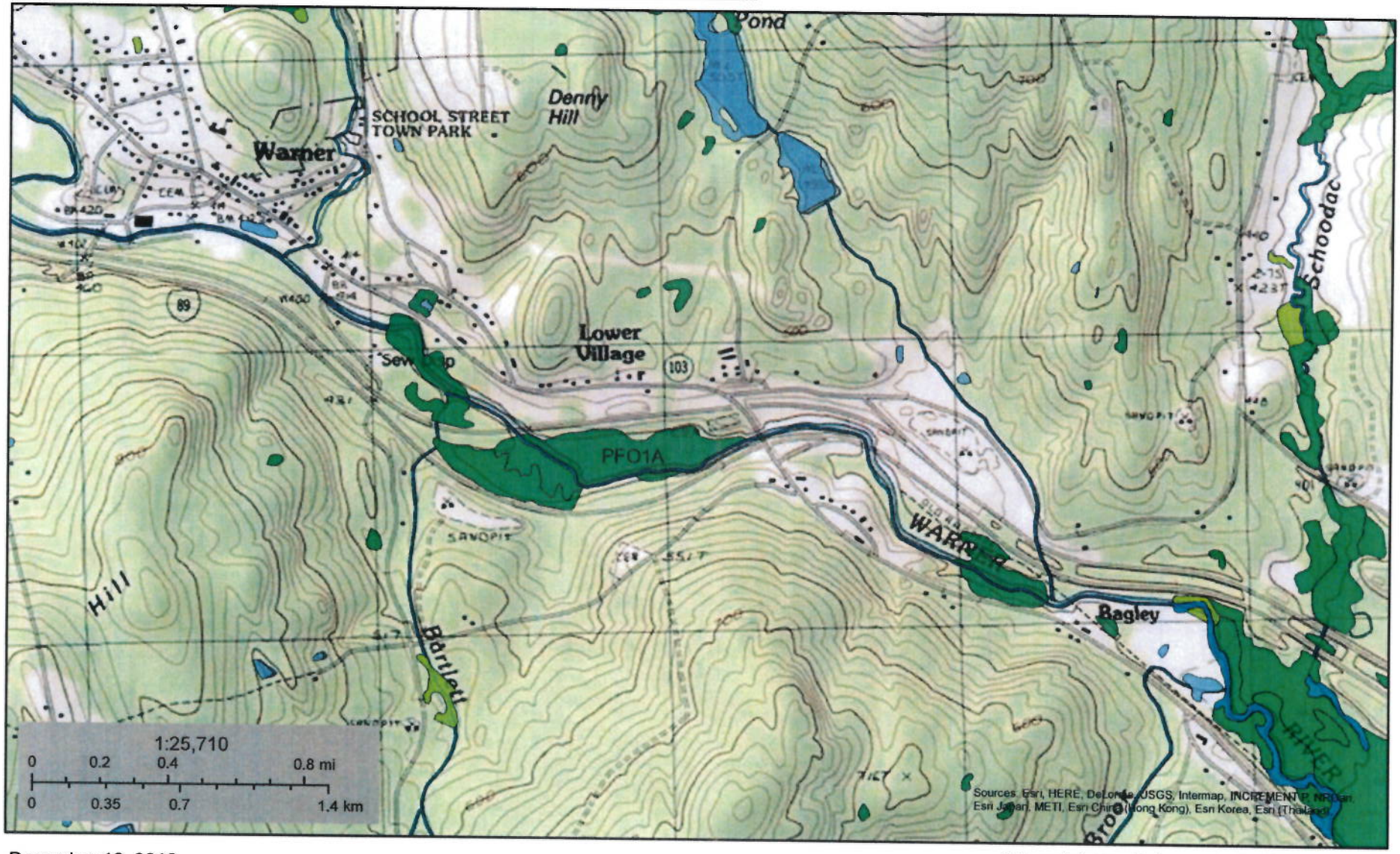
Map Generated: 12/22/2016

Notes

U.S. Fish and Wildlife Service

National Wetlands Inventory

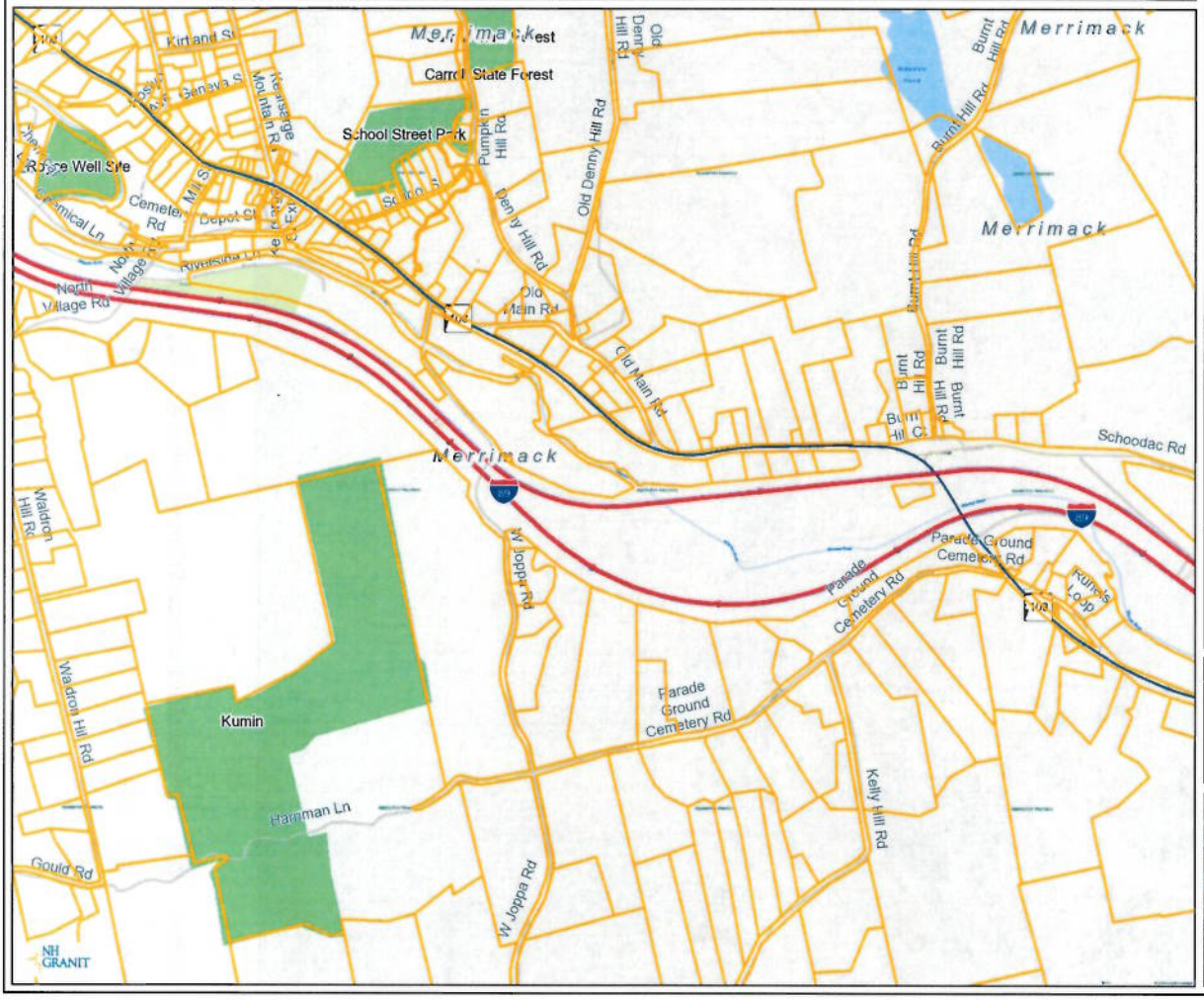
Warner GW Discharge Feasibility



December 19, 2016

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

Parcels and Conservation Areas



Legend

- Parcels - polygons
- State
- County
- City/Town
- Interstates
- Turnpikes
- US Routes
- State Routes
- Local Roads
- CL: Generic

Map Scale
1: 14,650

Map Generated: 12/22/2016

Notes

Wellhead Protection Areas

Legend

Wellhead Protection Areas

Map Scale
1: 12,988

Map Generated: 12/22/2016

Notes

Warner Village Water District
Groundwater Discharge Feasibility

Study Parcel	Owner(s)	Identified Impediments
A	Map 10, Lot 38 Town of Warner	FEMA Regulatory Floodplain Town Park
B	Map 10, Lot 31 Jack Solomon 12 Norfolk Road Litchfield, CT 06759	Slope
	Map 10, Lot 35 Jack Solomon 22 Loud Lane Warner, NH 03278	Slope Probable bedrock 20" – 40"
	Map 10, Lot 36 Brian Bush 1072 Highland Drive Epsom, NH 03234	Slope Probable bedrock 20" - 40"
	Map 10, Lot 37 Mark Hoar 29 Province Road Concord, NH 03303	Slope Probable bedrock 20" – 40"
	Map 10, Lot 48 Alfred & Gail Hanson P.O. Box 253 Warner, NH 03278	Slope
	Map 10, Lot 49 Victor Kumin Trust 46 Harriman Lane Warner, NH 03278	Slope Conservation Land Probable bedrock 20" – 40"
C	Map 10, Lot 43 Stephen & Katherine Rumsis 36A Hastings Street West Roxbury, MA 02132	
	Map 10, Lot 44 Stephen LaBonte 103 Joppa Road West Warner, NH 03278	

	Map 10, Lot 54 Edward Ordway 170 Parade Ground Cemetery Road Warner, NH 03278 Map 10, Lot 54-1 Anne Goff 140 Parade Ground Cemetery Road Warner, NH 03278 Map 10, Lot 54-3 Peter Wyman P.O. Box 332 Warner, NH 03278	
D	Map 10, Lot 34 State of New Hampshire	On NWI Map FEMA Regulatory Floodplain

Summary:

Study areas A and D have to be excluded based on the presence of delineated wetland areas and/or are in the FEMA Regulatory Floodplain.

The best area for further investigation is study area C, specifically lots 54, 54-1, and 54-3.

The second best area for further investigation is study area B.

APPENDIX 4
ANNOTATED WATER WELL MAP

Nearby Water Supply Wells

Legend

- Public Water Supply Wells
- Registered Water Users
- Water Well Inventory
  NH 2015 1-foot RGB

Depth to Bedrock (NHDES OneStop)

Beveridge: 167'
Ordway: 56'
Goff: 80'
Lader: 55'
Sammis: 240'

Map Scale
1: 6,494

Map Generated: 1/17/2017

Notes

APPENDIX 5
CONCEPTUAL GROUNDWATER DISCHARGE FIELD SIZING CALCULATIONS

NOAA Precipitation Data (in)
Station: Bradford

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2007	2.94	1.86	2.85	8.67	3.56	3.58	3.60	2.75	3.32	5.95	3.83	5.33	48.24
2008	2.53	9.55	6.04	4.58	0.74	6.66	5.12	4.48	6.56	3.29	4.93	6.50	60.98
2009	3.39	2.24	2.87	4.04	3.91	5.08	8.48	6.23	1.51	7.45	3.61	5.32	54.13
2010	2.80	5.26	8.19	2.53	2.23	3.12	4.67	2.49	2.48	9.63	3.39	4.13	50.92
2011	2.63	3.46	5.34	4.89	4.63	6.28	2.78	10.49	6.83	6.34	3.92	4.43	62.02
2012	3.54	0.69	2.00	2.54	5.91	4.47	3.72	2.28	5.57	6.65	0.37	5.46	43.20
2013	2.19	3.59	1.89	2.94	4.58	9.95	6.45	3.26	3.58	0.90	3.60	3.68	46.61
2014	3.58	4.06	4.11	3.37	4.59	5.14	8.52	5.46	1.6	7.64	3.23	6.19	57.49
2015	3.16	2.72	1.23	2.57	0.64	6.28	2.99	3.06	5.05	5.21	2.83	4.77	40.51
2016	1.76	4.58	3.95	1.75	2.59	2.31	3.56	2.99	1.75	4.88	2.35	4.12	36.59

horizons Engineering Inc.

Project No. 16133
Project Name WARNER GW DISCHARGE
Date 2/13/17
Prepared By B. COX

DRIP IRRIGATION FIELD SIZING PER NHDES "LAND TREATMENT AND DISPOSAL OF RECLAIMED WASTEWATER: GUIDANCE FOR GROUNDWATER DISCHARGE PERMITTING"

$$A = \frac{Q(FT^3/7.48GAL) \times 365\ DAY/YR + dV}{L_w \times N \times \left(\frac{FT}{IN}\right) \times 43,560\ FT^2/AC)}$$

A = FIELD AREA, IN AC
Q = WASTEWATER FLOW, IN GPD
dV = NET LOSS OR GAIN IN STORED WATER VOLUME BECAUSE OF PRECIPITATION AND/OR EVAPORATION, IN FT³/DAY
L_w = DESIGN HYDRAULIC LOADING RATE, IN IN/DAY
N = NUMBER OF DAYS OF OPERATION, IN DAYS/YR

$L_w = ET - P + W_p$

L_w = WASTEWATER HYDRAULIC LOADING RATE BASED ON SOIL, DEPTH/TIME
ET = DESIGN EVAPOTRANSPIRATION, DEPTH/TIME
P = DESIGN PRECIPITATION BASED ON WETTEST YEAR IN THE PREVIOUS 10 YEAR PERIOD, DEPTH/TIME
W_p = DESIGN PERCOLATION RATE, DEPTH/TIME

PRECIPITATION DATA (NOAA) FROM BRADFORD, NH 2007 - 2016
WETTEST YEAR 62.02" = 0.17"/DAY

EVAPOTRANSPIRATION (USGS) FROM 2 SOURCES
51 - 60 CM/YR = 20" - 23.6"/YR
15.27 IN/YR
} AVG = 21"/YR = 0.06"/DAY

PERCOLATION RATE: ASSUME 6"/HR FOR FINE SAND. ASSME A FACTOR OF SAFETY OF 10 = 0.6"/HR = 14.4"/DAY

∴ L_w = 0.06 - 0.17 + 14.4 = 14.3 "/DAY

horizons Engineering Inc.

Project No._____
Project Name_____
Date_____
Prepared By_____

$dV = P - ET = .17 - 0.06 = 0.11\text{"/DAY} = \frac{.11"}{12} \times 43560 = 399\ FT^3/DAY$

$$A = \frac{100{,}000\ GPD \times 365 + 399}{14.3 \times 365 \div 12 \times 43{,}560} = 1.9\ AC$$

AS A CHECK THE CALCULATION WAS PERFORMED USING A SPREADSHEET PREPARED BY GEOFLOW, INC.

PER TABLE 1 OF THE DESIGNER'S GUIDE, THE MAXIMUM MONTHLY LOADING RATE FOR SAND IS 1.2 GAL/FT²/DAY

THE SPREADSHEET CALCULATES A FIELD SIZE OF 83,333 FT² OR 1.9 AC

ASSUMING A FINE SAND LOADING RATE OF 0.9 GAL/FT²/DAY RESULTS IN A FIELD SIZE OF 111,111 FT² OR 2.5 AC

GEOFLOW SUBSURFACE DRIP

Field Flow

Job Description:	*Warner Village Water District*
Contact:	
Prepared by:	*B. Cox*
Date:	*25-Apr-13*

Please fill in the shaded areas and drop down menus:
This spreadsheet serves as a guide, and is not a complete hydraulic design.

Worksheet 1- Field Flow

Total field

Total Quantity of effluent to be disposed per day	100,000	gallons / day
Hydraulic loading rate	1.2	gallons / sq.ft. / day
Minimum Dispersal Field Area	83,333	square ft.
Total Dispersal Field Area	83,333	square ft.

Flow per zone

Number of Zones	**4**	zone(s)
Dispersal area per zone	20,833	square ft.
Choose line spacing between WASTEFLOW lines	2	ft.
Choose emitter spacing between WASTEFLOW emitters	2	ft.
Total linear ft.per zone (minimum required)	10,417	ft. per zone
Total number of emitters per zone	5,208	emitters per zone
Select Wasteflow dripline (16mm)	Wasteflow Classic	dripline
Pressure at the beginning of the dripfield	20	psi
Feet of Head at the beginning of the dripfield	46.2	ft.
What is the flow rate per emitter in gph?	1.16	gph
Dose flow per zone	**100.69**	**gpm**